Magnetic/Osmotic/Surface Tension-Based Omnidirectional "Printerless" Additive Manufacturing to Facilitate Efficient Residential and Commercial Construction

4 October 2022
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Introduction

Additive manufacturing promises to transform the way in which many commodities are manufactured, including residential and commercial buildings.

Abstract

There are two primary limitations on the cost-effectiveness of the additive manufacturing of buildings as the process is conducted at present. The first problem is one which my proposed method does little to change, that problem being that there are many things found in homes that cannot be practically incorporated into the "unibody" of the structure. The basic structure; the roof, floors, ceilings, thresholds, door frames, hand rails, stairs, et cetera sc. coarse features that do not involve moving or sliding parts can certainly be constructed, even with existing methods, using very large, football field-sized printers. Things like windows, cabinets, door hinges and the like would have to be built the traditional way and added to the basic structure later. Things such as plumbing and even fixtures can be incorporated into the home's superstructure, but the internal components of a toilet's tank such as the rubber stopper and chain, the moving handle, and so on, would need to be added the old-fashioned way.

Despite the fact that printed structures do not get "all of the work" of building a home out of the way, the work of building the frame, internal and external walls, internal plumbing, floors, and roof comprises roughly 80% of the material and labor costs involved.

That said, there is a second factor that makes "printing" homes nearly as costly as traditional building, at least in its current form. That factor is the scale and cost of the machines that are used to build these structures, which need to be physically larger than the footprint of the structures to be built. As the process stands today, to be economical, entire developments must be built at once and the machinery used must work with few faults.

If we could take the physical "printer" out of the picture in structural printing, it would open the door to building at a much lower cost versus the currently prevalent system.

By combining elements of the fields of nano-robotics and materials sciences, it is possible to build a structure without a printer by taking advantage of several tools that either already exist or could be designed using existing technologies.

The most basic version of the concept entails building a structure including foundation, frame, interior and exterior walls, plumbing, ductwork, floors, ceilings, and roof out of a single material type and into a single unibody structure using a novel form of additive manufacturing.

Ordinary additive manufacturing requires that material be "added from above" and "stacked." Inconveniently, one has to find a way to approach the "writing surface" from above. Traditionally, this has meant utilizing an elevated printer head dozens of feet above the ground, suspended by a steel structure that in and of itself resembles the frame of a large building.

So as to avoid these complications, I propose a method involving the use of electrostatically-propelled, magnetically and optically functional nanobots powered by induction from a power source capable of transmitting power from up to 100 feet away. These nanobots would be used not to form the structure of a building, but to act as tiny pairs of hands that magnetically push the construction material in desired directions or prohibit the further accumulation of the liquid-form material in areas where accumulation is undesired.

The construction medium in this system would be a liquid polymer with a ferrous component that makes it manipulable by magnetic fields while also featuring lipid-like hydrophobic properties including high surface tension. This high surface tension would mean that the polymer, in its liquid form, would be capable of "crawling up" walls of a structure already partly constructed, mostly driven by osmotic forces, but guided in part by the magnetic fields generated by the nanobots.

Ultimately, this means that the liquid construction medium may be pumped in from something like a cement truck that keeps the material in its liquid state and pours the material into a sluice at a single corner of the structure at ground level. Computer-guided magnetic nanobots then direct the osmotic spread using their collective magnetic north poles to accelerate and/or restrict the flow of the liquid over top of the already-solidified aspects of the structure.

Once a given liquid layer diffuses over the existing solid structure, a different set of nanobots designed to emit ultraviolet light rather than magnetism activate. That light interacts with the polymer, causing it to solidify. Both the magnetic and optical nanobots work in tandem to hold concentrations of the liquid-form material in place and to solidify them on a layer-by-layer basis.

As within this system, material can osmote from the bottom of the structure upward, there is no need for bulky equipment to "get at" the writing surface from above. The nanobots, be they of the magnetic or optical variety, would all be electrostatically propelled, airborne, and induction-powered. The area above a door frame, for instance, could work its way down from the ceiling much like a stalactite in a cave until it reaches the desired distance from the floor, at which point, the nanobots would use their magnetic fields to prohibit the further accumulation of material.

Ultimately, the bulk of the work involved in constructing the essential elements of a home could be completed without human intervention while

giving architects a great deal of creative freedom in terms of design. While dark-colored polymers would work best in terms of responsiveness to UV light in the solidification process and would therefore make for the strongest structure, the final internal and external coatings could be of whichever color one desires aesthetically. Traditional windows, doors, cabinets, and anything else not able to be built using the additive method would by necessity be installed as part of the final step of the home construction process.

Polymers are naturally sturdy and are in and of themselves sufficiently insulative to meet the needs of dwellers. Thus, the installation of insulation is yet another construction element made redundant by this approach.

Conclusion

Perhaps the most challenging aspects of realizing this concept will be designing nanobots with a sufficient sophistication to be able to accept needed commands from a controlling computer to achieve the desired objectives as well as bestowing upon that computer the ability to control billions of airborne nanobots wirelessly and in real time. That said, provided the robotic components called for can be constructed, it does not take much imagination to visualize how these structures will seem to self-assemble with the greatest of ease and how this approach can revolutionize construction.